

SN54251, SN54LS251, SN54S251, SN74251, SN74LS251, (TIM9905), SN74S251 DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

DECEMBER 1972—REVISED MARCH 1988

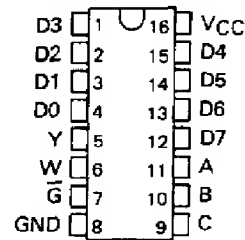
- Three-State Versions of '151, 'LS151, 'S151
- Three-State Outputs Interface Directly with System Bus
- Perform Parallel-to-Serial Conversion
- Permit Multiplexing from N-lines to One Line
- Complementary Outputs Provide True and Inverted Data
- Fully Compatible with Most TTL Circuits

SN54251, SN54LS251, SN54S251 . . . J OR W PACKAGE

SN74251 . . . N PACKAGE

SN74LS251, SN74S251 . . . D OR N PACKAGE

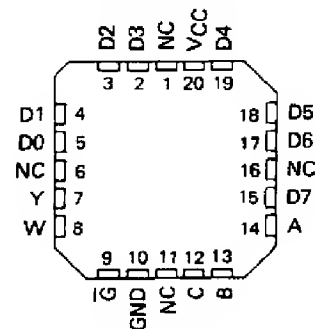
(TOP VIEW)



TYPE	MAX NO. OF COMMON OUTPUTS	TYPICAL AVG PROP DELAY TIME (D TO Y)	TYPICAL POWER DISSIPATION
SN54251	49	17 ns	250 mW
SN74251	129	17 ns	250 mW
SN54LS251	49	17 ns	35 mW
SN74LS251	129	17 ns	35 mW
SN54S251	39	8 ns	275 mW
SN74S251	129	8 ns	275 mW

SN54LS251, SN54S251 . . . FK PACKAGE

(TOP VIEW)



NC - No internal connection

description

These monolithic data selectors/multiplexers contain full on-chip binary decoding to select one-of-eight data sources and feature a strobe-controlled three-state output. The strobe must be at a low logic level to enable these devices. The three-state outputs permit a number of outputs to be connected to a common bus. When the strobe input is high, both outputs are in a high-impedance state in which both the upper and lower transistors of each totem-pole output are off, and the output neither drives nor loads the bus significantly. When the strobe is low, the outputs are activated and operate as standard TTL totem-pole outputs.

To minimize the possibility that two outputs will attempt to take a common bus to opposite logic levels, the output control circuitry is designed so that the average output disable time is shorter than the average output enable time. The SN54251 and SN74251 have output clamp diodes to attenuate reflections on the bus line.

FUNCTION TABLE

INPUTS				OUTPUTS	
SELECT			ENABLE	Y	W
C	B	A	\bar{G}		
X	X	X	H	Z	Z
L	L	L	L	D0	$\bar{D0}$
L	L	H	L	D1	$\bar{D1}$
L	H	L	L	D2	$\bar{D2}$
L	H	H	L	D3	$\bar{D3}$
H	L	L	L	D4	$\bar{D4}$
H	L	H	L	D5	$\bar{D5}$
H	H	L	L	D6	$\bar{D6}$
H	H	H	L	D7	$\bar{D7}$

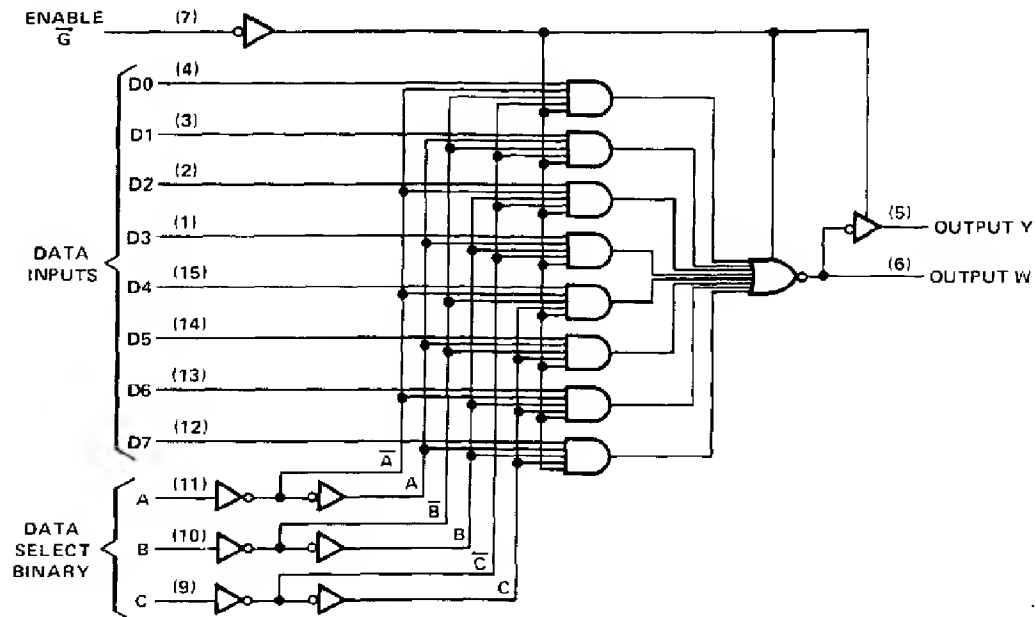
H = high logic level, L = low logic level

X = irrelevant, Z = high impedance (off)

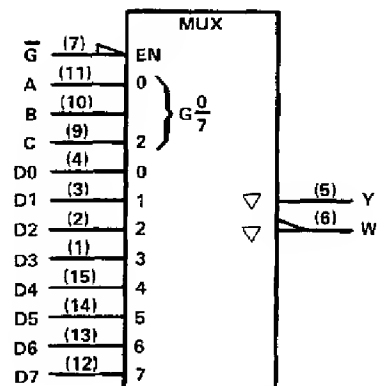
D0, D1 . . . D7 = the level of the respective D input

**SN54251, SN54LS251, SN54S251,
SN74251, SN74LS251, (TIM9905), SN74S251
DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS**

logic diagram (positive logic)



logic symbol†



†This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, N, and W packages.

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SN54251, SN74251

DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	5.5 V
Off-state output voltage	5.5 V
Operating free-air temperature range: SN54251	-55°C to 125°C
SN74251	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54251			SN74251			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			-2			-5.2	mA
Low-level output current, I_{OL}			16			16	mA
Operating free-air temperature, T_A	-55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		MIN	TYP‡	MAX	UNIT
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN.}$ $I_I = -12 \text{ mA}$				-1.5	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN.}$ $V_{IL} = 0.8 \text{ V.}$ $I_{OH} = \text{MAX}$		2.4	3.2		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN.}$ $V_{IL} = 0.8 \text{ V.}$ $I_{OL} = 16 \text{ mA}$			0.2	0.4	V
I_{OZ}	Off-state (high-impedance-state) output current	$V_{CC} = \text{MAX.}$ $V_{IH} = 2 \text{ V}$	$V_O = 2.4 \text{ V}$ $V_O = 0.4 \text{ V}$			40 -40	µA
V_O	Output clamp voltage	$V_{CC} = \text{MAX.}$ $V_{IH} = 4.5 \text{ V}$	$I_O = -12 \text{ mA}$ $I_O = 12 \text{ mA}$			-1.5 $V_{CC} + 1.5$	V
I_I	Input current at maximum input voltage	$V_{CC} = \text{MAX.}$ $V_I = 5.5 \text{ V}$				1	mA
I_{IH}	High-level input current	$V_{CC} = \text{MAX.}$ $V_I = 2.4 \text{ V}$				40	µA
I_{IL}	Low-level input current	$V_{CC} = \text{MAX.}$ $V_I = 0.4 \text{ V}$				-1.6	mA
I_{OS}	Short-circuit output current§	$V_{CC} = \text{MAX.}$		-18		-55	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX.}$ All inputs at 4.5 V, All outputs open			38	62	mA

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.

‡All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

§Not more than one output should be shorted at a time.

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SN54251, SN74251
DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{ C}$

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
tPLH	A, B, or C (4 levels)	Y	CL = 50 pF, RL = 400 Ω, See Note 2	29	45	ns	
tPHL				28	45		
tPLH	A, B, or C (3 levels)	W		20	33	ns	
tPHL				21	33		
tPLH	Any D	Y		17	28	ns	
tPHL				18	28		
tPLH	Any D	W		10	15	ns	
tPHL				9	15		
tPZH	G	Y		17	27	ns	
tPZL				26	40		
tPZH	G	W		17	27	ns	
tPZL				24	40		
tPHZ	G	Y	CL = 5 pF, RL = 400 Ω, See Note 2	5	8	ns	
tPLZ				15	23		
tPHZ	G	W		5	8	ns	
tPLZ				15	23		

† t_{PLH} = Propagation delay time, low-to-high-level output

t_{PHL} = Propagation delay time, high-to-low-level output

t_{PZH} = Output enable time to high level

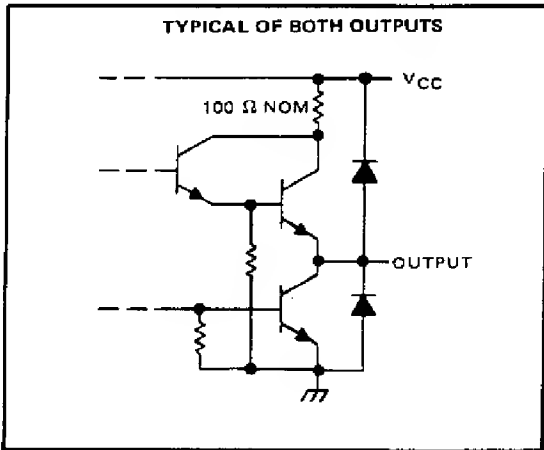
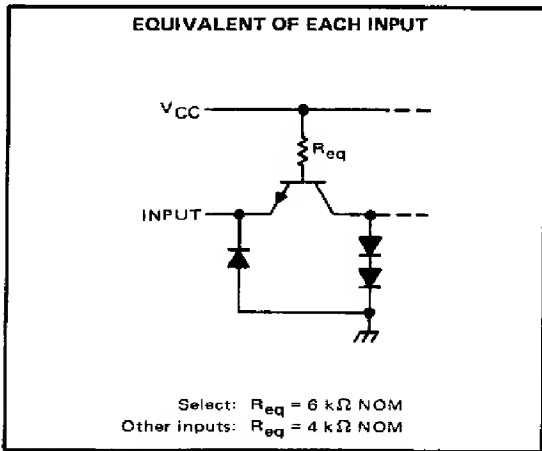
t_{PZL} = Output enable time to low level

t_{PHZ} = Output disable time from high level

t_{PLZ} = Output disable time from low level

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

schematics of inputs and outputs



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SN54LS251, SN74LS251

DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	7 V
Off-state output voltage	5.5 V
Operating free-air temperature range: SN54LS251	55°C to 125°C
SN74LS251	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54LS251			SN74LS251			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC} Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V_{IH} High-level input voltage	2			2			V
V_{IL} Low-level input voltage			0.7			0.8	V
I_{OH} High-level output current			-1			-2.6	mA
I_{OL} Low-level output current			4			8	mA
T_A Operating free-air temperature	-55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS†		SN54LS251		SN74LS251		UNIT
			MIN	TYP ‡ MAX	MIN	TYP ‡ MAX	
V_{IK}	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.5		-1.5	V
V_{OH}	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}$ $I_{OH} = \text{MAX}$		2.4	3.4	2.4	3.1	V
V_{OL}	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}$	$I_{OL} = 4 \text{ mA}$	0.25	0.4	0.25	0.4	V
		$I_{OL} = 8 \text{ mA}$			0.35	0.5	
I_{OZ}	$V_{CC} = \text{MAX}, V_{IH} = 2 \text{ V}$	$V_O = 2.7 \text{ V}$		20		20	μA
		$V_O = 0.4 \text{ V}$		-20		-20	
I_I	$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$			0.1		0.1	mA
I_{IH}	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$			20		20	μA
I_{IL}	Enable \bar{G} All other	$V_{CC} = \text{MAX}, V_I = 0.4$		-0.2		-0.2	mA
				-0.4		-0.4	
$I_{OS}§$	$V_{CC} = \text{MAX}$		-30	-130	-30	-130	mA
I_{CC}	$V_{CC} = \text{MAX}, \text{ See Note 3}$	Condition A	6.1	10	6.1	10	mA
		Condition B	7.1	12	7.1	12	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

NOTE 3: I_{CC} is measured with the outputs open and all data and select inputs at 4.5 V under the following conditions:

- A. Enable grounded.
- B. Strobe at 4.5 V.



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SN54LS251, SN74LS251 (TIM9905) **DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS**

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
tPLH	A, B, or C (4 levels)	Y	CL = 15 pF, RL = 2 kΩ, See Note 2		29	45	ns
tPHL					28	45	
tPLH	A, B, or C (3 levels)	W			20	33	ns
tPHL					21	33	
tPLH	Any D	Y			17	28	ns
tPHL					18	28	
tPLH	Any D	W			10	15	ns
tPHL					9	15	
tPZH	G	Y			30	45	ns
tPZL					26	40	
tPZH	G	W			17	27	ns
tPZL					24	40	
tPHZ	G	Y	CL = 5 pF, RL = 2 kΩ, See Note 2		30	45	ns
tPLZ					15	25	
tPHZ	G	W			37	55	ns
tPLZ					15	25	

† t_{PLH} = Propagation delay time, low-to-high-level output

t_{PHL} = Propagation delay time, high-to-low-level output

t_{PZH} = Output enable time to high level

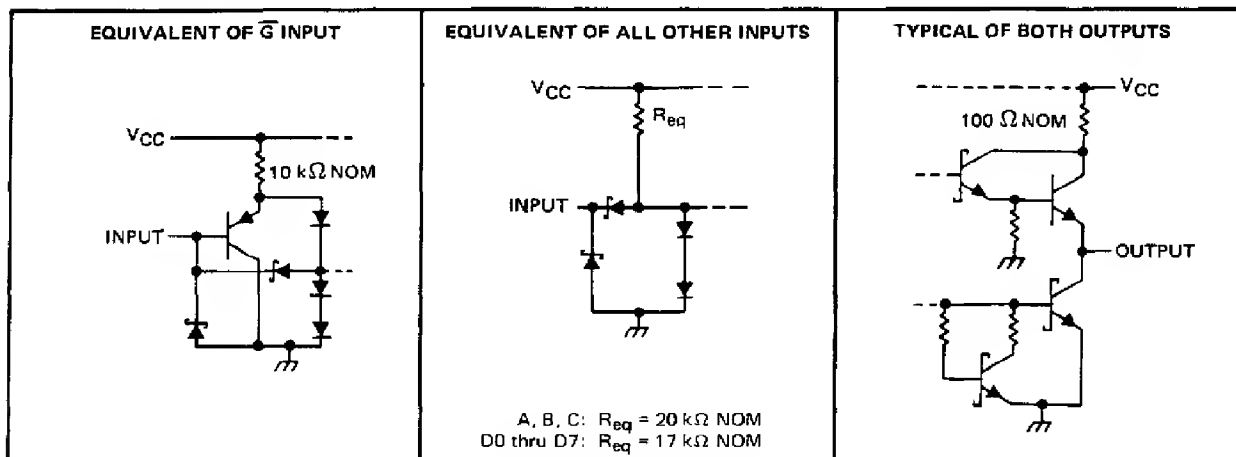
t_{PZL} = Output enable time to low level

t_{PHZ} = Output disable time from high level

t_{PLZ} = Output disable time from low level

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

schematics of inputs and outputs



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SN54S251, SN74S251

DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	5.5 V
Off-state output voltage	5.5 V
Operating free-air temperature range: SN54S251	-55°C to 125°C
SN74S251	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54S251			SN74S251			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			-2			-6.5	mA
Low-level output current, I_{OL}			20			20	mA
Operating free-air temperature, T_A	-55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		MIN	TYP‡	MAX	UNIT
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN.}$ $I_I = -18 \text{ mA}$				-1.2	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN.}$ $V_{IL} = 0.8 \text{ V.}$ $I_{OH} = \text{MAX}$	SN54S*	2.4	3.4		V
			SN74S*	2.4	3.2		
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN.}$ $V_{IL} = 0.8 \text{ V.}$ $I_{OL} = 20 \text{ mA}$				0.5	V
I_{OZ}	Off-state (high-impedance-state) output current	$V_{CC} = \text{MAX.}$ $V_{IH} = 2 \text{ V}$	$V_O = 2.4 \text{ V}$			50	μA
			$V_O = 0.5 \text{ V}$			-50	
I_I	Input current at maximum input voltage	$V_{CC} = \text{MAX.}$ $V_I = 5.5 \text{ V}$				1	mA
I_{IH}	High-level input current	$V_{CC} = \text{MAX.}$ $V_I = 2.7 \text{ V}$				50	μA
I_{IL}	Low-level input current	$V_{CC} = \text{MAX.}$ $V_I = 0.5 \text{ V}$				-2	mA
I_{OS}	Short-circuit output current	$V_{CC} = \text{MAX.}$		-40		-100	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX.}$ All inputs at 4.5 V, All outputs open			55	85	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.

‡ All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

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SN54S251, SN74S251 **DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS**

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
tPLH	A, B, or C (4 levels)	Y	CL = 15 pF, RL = 280 Ω, See Note 2		12	18	ns
tPHL					13	19.5	
tPLH	A, B, or C (3 levels)	W			10	15	ns
tPHL					9	13.5	
tPLH	Any D	Y			8	12	ns
tPHL					8	12	
tPLH	Any D	W			4.5	7	ns
tPHL					4.5	7	
tPZH	G	Y	CL = 50 pF, RL = 280 Ω, See Note 2		13	19.5	ns
tPZL					14	21	
tPZH	G	W			13	19.5	ns
tPZL					14	21	
tPHZ	G	Y	CL = 5 pF, RL = 280 Ω, See Note 2		5.5	8.5	ns
tPLZ					9	14	
tPHZ	G	W			5.5	8.5	ns
tPLZ					9	14	

† t_{PLH} = Propagation delay time, low-to-high-level output

t_{PHL} = Propagation delay time, high-to-low-level output

t_{PZH} = Output enable time to high level

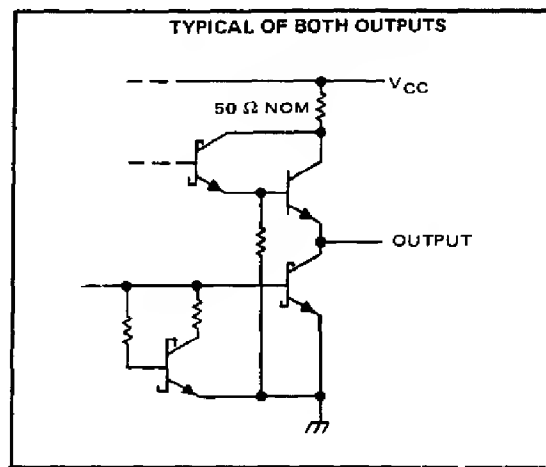
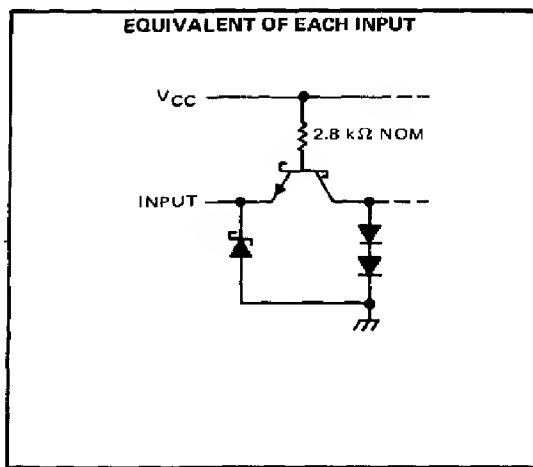
t_{PZL} = Output enable time to low level

t_{PHZ} = Output disable time from high level

t_{PLZ} = Output disable time from low level

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

schematics of inputs and outputs



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